

Incrementum ad Absurdum: Global Growth, Inequality and Poverty Eradication in a Carbon-Constrained World

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Abstract

The paper seeks to assess the timeframe for eradication of poverty, defined by poverty lines of \$1.25 and \$5 per person per day at 2005 purchasing power parity, if pre-crisis (1993-2008) patterns of income growth were maintained indefinitely, taking account of the differential performance of China. On the basis of optimistic assumptions, and implicitly assuming an indefinite continuation of potentially important pro-poor shifts in development policies during the baseline period, it finds that eradication will take at least 100 years at \$1.25-a-day, and 200 years at \$5-a-day. While this could in principle be brought forward by accelerating global growth, global carbon constraints raise serious doubts about the viability of this course, particularly as global GDP would need to exceed \$100,000 per capita at \$1.25-a-day, and \$1m per capita at \$5-a-day. The clear implication is that poverty eradication, even at \$1.25-a-day, and especially at a poverty line which better reflects the satisfaction of basic needs, can be reconciled with global carbon constraints only by a major increase in the share of the poorest in global economic growth, far beyond what can realistically be achieved by existing instruments of development policy – that is, by effective measures to reduce global inequality.

Keywords: economic growth, inequality, carbon constraints, poverty, income distribution, poverty eradication

The United Nations High-Level Panel on the Post-2015 Development Agenda (2013) has proposed as a central development goal for the post-2015 period the eradication by 2030 of extreme poverty, as defined by the poverty line of \$1.25 per person per day at 2005 purchasing power parity. This follows a number of studies seeking to estimate the extent of poverty reduction over this period as a basis for discussions of post-2015 development goals (eg Karver *et al.*, 2012; Chandy *et al.*, 2013; Ravallion, 2013).

The author has argued elsewhere (Woodward, 2013) that the shift from poverty reduction to poverty eradication is very welcome and entirely appropriate, but that the latter is qualitatively different from the former, and has major implications for our approach to development, particularly in relation to the relative importance of global economic growth and the global distribution of income. This article develops this theme by considering the likely timeframe for the eradication of poverty, based both on the \$1.25-a-day line and a poverty line of \$5-a-day, which is considered as a more realistic reflection of requirements to fulfil basic needs, on the basis of pre-crisis (pre-2008) trends. Adapting and improving the methodology developed in an earlier paper (Woodward and Simms, 2006, whose results are also updated), the article extrapolates pre-crisis (1993-2008) trends in global GDP growth and in income growth in the lower deciles of the world population. Since poverty reduction has hitherto been largely driven by China, whose greatly reduced incidence of poverty will considerably diminish its effect on poverty trends in the future, it bases its findings primarily on analysis of the world excluding China.

Adopting this as a baseline scenario, the article considers the implications of variations in the two basic variables, the rate of global economic growth and the growth rate of per capita income of the poorest decile relative to global GDP per capita in the context of environmental (and particularly carbon) constraints to long-term growth of the global economy.

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All poverty data used in this article are taken from PovcalNet, the on-line tool for poverty measurement developed by the Development Research Group of the World Bank.² The methodology for estimating decile average incomes is described in the Annex to this paper.

1. “Growth Isn’t Working” revisited

Woodward and Simms (2006) presented estimates of the share in global economic growth accruing to those below the (former) “\$1-a-day” and “\$2-a-day” poverty lines, at 1985 purchasing power parity, between 1981 and 2001. Since then, not only have later data become available (up to 2008), but the entire PovcalNet database has been updated to 2005 purchasing power parity.

Table 1 and Figures 1 and 2 present an updated version of the estimates presented in Table 4 and Figures 7-8 of Woodward and Simms (2006), following the World Bank in changing the lower poverty line to \$1.25 per day, while leaving the upper poverty line unchanged at \$2 per day at 2005 purchasing power parity.

Table 1: Changes in Incomes of Poor Households

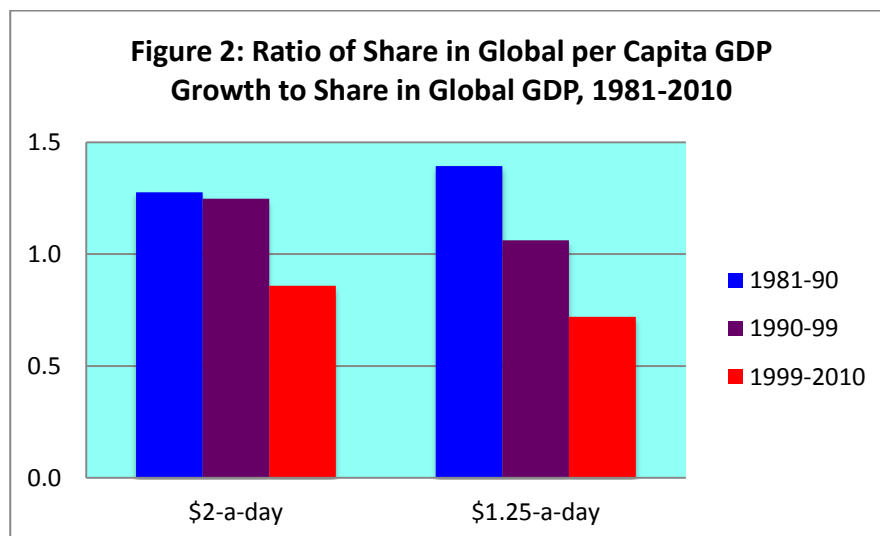
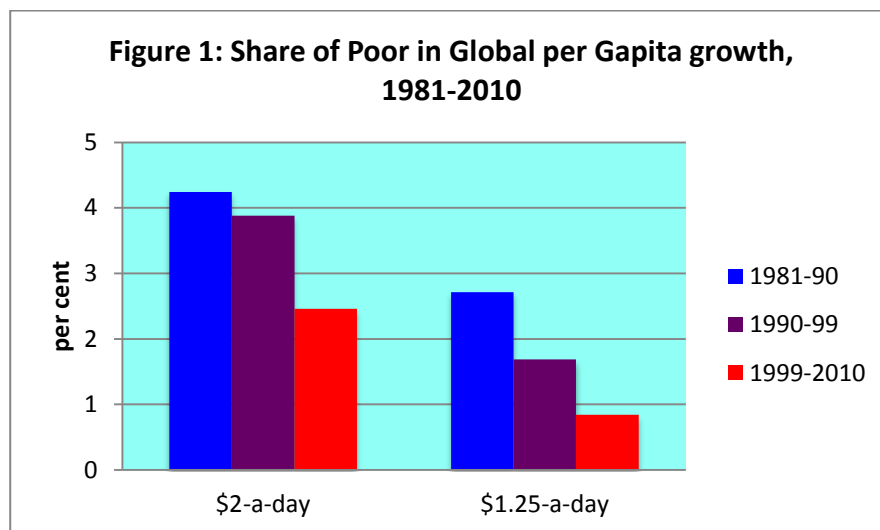
		\$1.25-a-day			\$2-a-day		
		1981-90	1990-99	1999-10	1981-90	1990-99	1999-10
without population adjustment	poverty reduction (\$bn)	216	164	193	377	364	532
	change in world GDP(\$bn)	9,132	9,963	21,717	9,132	9,963	21,717
	poverty reduction as % of change in GDP	2.37	1.65	0.89	4.13	3.65	2.45
	income of poor as % of GDP	1.95	1.59	1.17	3.32	3.11	2.67
	ratio of share in growth to share in GDP	1.22	1.04	0.76	1.24	1.17	0.92
with population adjustment	poverty reduction (\$bn)	106	62	84	165	143	246
	change in world GDP (\$bn)	3,898	3,689	9,983	3,898	3,689	9,893
	poverty reduction as % of change in GDP	2.71	1.69	0.84	4.24	3.88	2.46
	income of poor as % of GDP	1.95	1.59	1.17	3.32	3.11	2.67
	ratio of share in growth to share in GDP	1.39	1.06	0.72	1.28	1.25	0.86

² <http://iresearch.worldbank.org/PovcalNet/index.htm?0,2>

The historical results are significantly different from those presented in Woodward and Simms (2006), and appear to present a significantly less pessimistic picture of poverty in the 1980s and 1990s: both the share of poor households in global GDP growth and the ratio of this share to their initial share in GDP are higher in both the 1980s and the 1990s (except at the \$2-a-day level in the 1980s, where the two figures are approximately equal), and the reduction between the 1980s and 1990s is less marked; and the ratio remains greater than unity at both the \$1.25 and the \$2 level.

However, there is again a marked reduction in both the share of global growth and the ratio to share in GDP at both poverty levels from 1999 to 2010. It will be noted, however, that the ratio at the \$1.25 level in 1999-2008 remains substantially higher than in the earlier analysis, at 0.76 (as compared with 0.51).

To update one of the widely cited findings in the earlier analysis, the greater share of the \$1.25-a-day poor in global per capita growth in 1999-2010 than of the \$1-a-day poor in 1990-2001 (0.89% cf 0.60%) suggests that \$111 of additional growth in global GDP is required to achieve each \$1 reduction in poverty, based on the \$1.25-a-day poverty line, as compared with \$166 (based on the then \$1.08-a-day line) in the earlier analysis. It should be noted, however, that this change essentially reflects the much greater proportion of the population categorised as “poor” by the \$1.25 poverty line in 1999 than by the \$1.08-a-day line in 1990 (the first year of the final sub-period in each case) – 34.1%, as compared with 23.2%. Adopting a poverty line equivalent to the \$1-a-day line (in terms of the corresponding poverty headcount) would clearly give rise to a figure well above \$111.



There are, however, a number of reasons for caution in comparing the two sets of historical results. First, while the poverty lines defined at 1985 and 2005 PPP are not directly comparable, a comparison of the poverty headcount ratios to which they give rise indicates that the \$1.25 line at 2005 PPP effectively represents a higher line than the \$1-a-day line at 1993 PPP. In fact, by this measure, the \$1.25-a-day line at 2005 purchasing power parity might be considered broadly equivalent to the \$2-a-day line at 1985 PPP at the beginning of the period: the headcount ratio given by the \$1.25-a-day line in 1981 gives a headcount ratio of 52.2% in 1981, only marginally below the 54.3% indicated by the earlier \$2-a-day line.

If, accordingly, we compare the current \$1.25-a-day results with the earlier \$2-a-day results, we find that the share in growth is now little more than half the earlier figure, and exhibits a similar proportional reduction between the 1980s and 1990s (from 2.7% to 1.7%, as against a reduction from 5.3% to 3.1%). However, the ratio to GDP share is slightly higher, and falls somewhat less (from 1.39 to 1.06, as against a reduction from 1.25 to 0.8), consequently remaining greater than unity until 1999.

A second consideration is the change in periods covered: while the second period in the earlier analysis was from 1990 to 2001, that in the current analysis ends in 1999. While poverty reduction between 1999 and 2002 does not appear to have been substantially out of line with the overall pattern for the period as a whole, a minor effect on the results cannot be ruled out.

Third, at any point in time, the most recent poverty estimates (as those for 2001 in the earlier analysis) are partially based on extrapolation from past trends in countries for which no recent survey data are available. As subsequent data become available, these extrapolated estimates are replaced with actual survey data or (more reliable) interpolated estimates. Again, this may affect the earlier estimates for the 1990s to some extent. However, to the extent that extrapolated estimates exhibit an optimistic bias (as argued in Woodward and Abdallah, 2006, pp 16-18), one would expect this effect to operate in the opposite direction to that observed, rendering the earlier results artificially optimistic.

Finally, the change from 1993 to 2005 purchasing power is itself likely to have had a substantial, though indeterminate, effect on the historical results, as such revisions give rise to serious issues of consistency (Woodward and Abdallah, 2010, pp. 10-11).

At first sight, this might appear to be a case for preferring the current results to the earlier ones, as they are based on a more recent PPP. However, it is far from clear that this is justified. In assessing historical trends, it would seem appropriate to adopt a base year for purchasing power parity as close as possible to the mid-point of the period under consideration. For the historical (1981-99, mid-point 1990) estimates, this rule of thumb would suggest a preference for 1985 rather than 2005 (although the converse would clearly apply to the 1999-2008 results).

In this particular context, however, there is arguably a further reason to prefer the earlier base-year. Since PPP estimates are based on GDP weights and not consumption patterns of poor households, the question is whether the composition of poor households' consumption between 1981 and 2008 is closer to 1985 GDP weights or to 2005 GDP weights. While the difference in both cases is likely to be considerable, there would seem to be a strong intuitive case for preferring weights from 1985, when GDP per capita was substantially lower, and thus less far removed from the \$1/1.25- and \$2-a-day poverty lines.

In summary, while the revised estimates presented here may appear indicative of a significantly less pessimistic picture of poverty reduction in the 1990s than that suggested by the results in Woodward and Simms (2006), this appears to arise in large measure from the change in the definition of poverty associated with the updating to 2005 purchasing parity. The change in PPP base year itself may also have some effect; but in the particular context of poverty analysis, there is no clear reason to prefer a later to an earlier base-year; and, for historical analysis, there would seem a strong *prima facie* case for preferring a base year during the period analysed to a subsequent base year. Thus the historical results presented here should not necessarily be viewed as superseding or invalidating the earlier results.

2. Limitations of the “Growth Isn’t Working” methodology

The foregoing discussion has adopted the methodology used in Woodward and Simms (2006) in order to reassess and update its results on the basis of subsequent data. However, while this approach has the merit

of direct relevance to policy discussions, in that it is based on internationally accepted poverty lines, this basis itself gives rise to two significant shortcomings.

First, while poverty is falling, the proportion of households defined as poor falls. Any observed reduction in the proportion of global growth contributing to poverty reduction will at least partly, and may wholly, reflect this change. This is the reason for the use of the ratio between growth shares and GDP shares, rather than shares in growth *per se*, as an indicator of changes in performance over time.

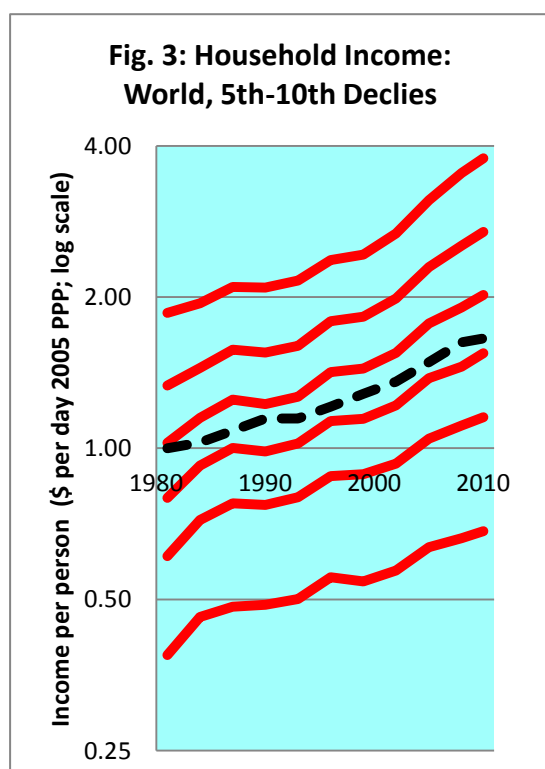
Second, however, the use of fixed poverty lines means that any increase in the income of a households beyond a particular poverty line is excluded from the contribution of growth to poverty reduction with respect to that poverty line. While reasonable in assessing the proportion of growth which reduces poverty defined by a particular poverty line, this is more problematic in assessing the ratio between the share in global growth and the share in global GDP, as the household's entire income is included in the GDP share, but only part of the increase in its income is included in its share in growth. This also makes estimated ratios sensitive to the length of the period considered: the longer the period, the more households will rise above the poverty line, and the greater the proportion of additional income which will be excluded.

(This is the reason for ensuring equal periods in the current analysis. It also suggests that the difference in sub-periods in the earlier study, at 9 years and 11 years, though inevitable given the format of the data, may have made a modest contribution to the estimated reduction in ratios.)

In the remainder of this paper, we therefore adopt an alternative approach which does not rely on the use of fixed poverty lines, but rather estimates the average per capita income of income deciles. This has the added advantage of side-stepping the issue of whether, and if so how, the results should be adjusted to for global population growth.

3. Evolution of incomes by decile of world population

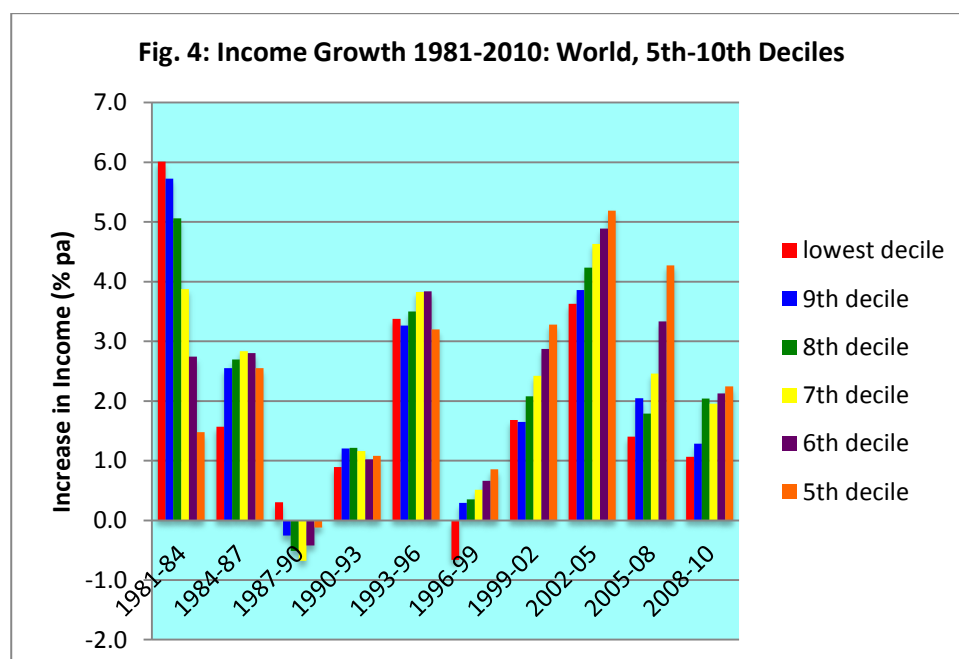
At first sight, progress in reducing poverty appears to have been substantial over the last 30 years. Despite the 1980s debt crisis, the Asian financial crisis of the late 1990s and concerns about the social impact of globalisation, incomes rose consistently in all income bands throughout the period, except in 1987-90 (when incomes fell in all except the lowest band) and 1993-6 (when they fell in the lowest band, with limited increases in all other bands). (See Figure 3.)



On closer inspection, however, there are some issues for concern. First, the rate of increase of incomes has been very erratic, with growth greater than 1.6% pa in only three three-year periods (1981-4, 1993-6 and 2002-5).

Second, given their very low initial levels, the average rate of growth suggests a very long timeframe for poverty eradication. The average per capita income for the bottom decile was \$0.68 per day in 2010, and the average growth rate 2.0% pa between 1981 and 2010 (1.4% pa from 1984), indicating a doubling every 35 years (51 years based on the post-1984 growth rate). It would thus take nearly this long for the average income of the poorest 10% to reach the \$1.25 a day poverty line, and considerably longer – well beyond the life expectancy of a child born into poverty today – for those at the bottom of this band. This issue is discussed in greater detail in the final section of this paper.

Third, the higher income bands performed significantly better than the lower bands. Over the period as a whole, the growth rate of incomes rises consistently across income bands, from across bands, from 2.0% pa in the lowest to 2.4% pa in the highest. More worryingly, this trend strengthened considerably through the period. While incomes in the lower bands grew much faster in the lower than in the lower bands in 1981-4, growth rates were broadly similar between 1984 and 1996, after which the gap between the two widened at an accelerating rate until 2008, moderating only partially in 2008-10. (See Figure 4.) From 1996, the average income growth again increased consistently across deciles, from 1.5% pa in the lowest decile to 3.7% pa in the fifth decile.

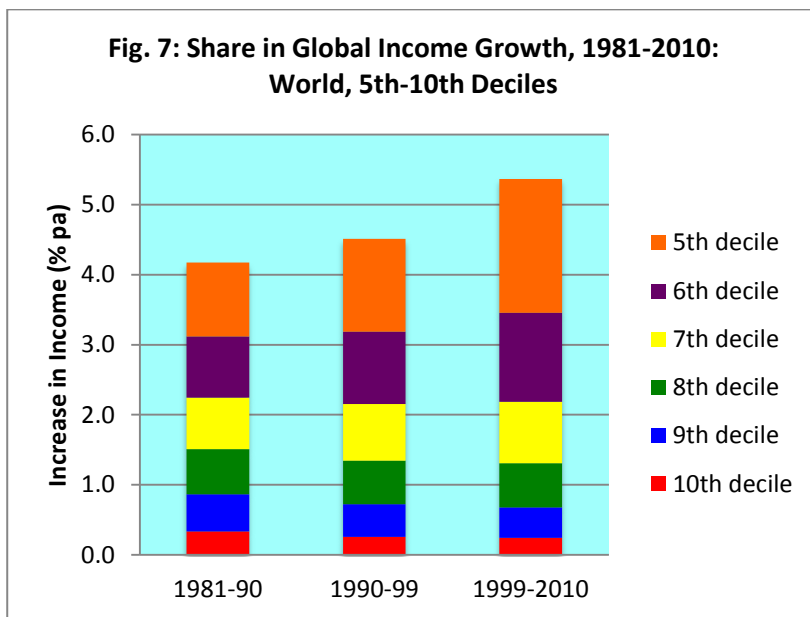
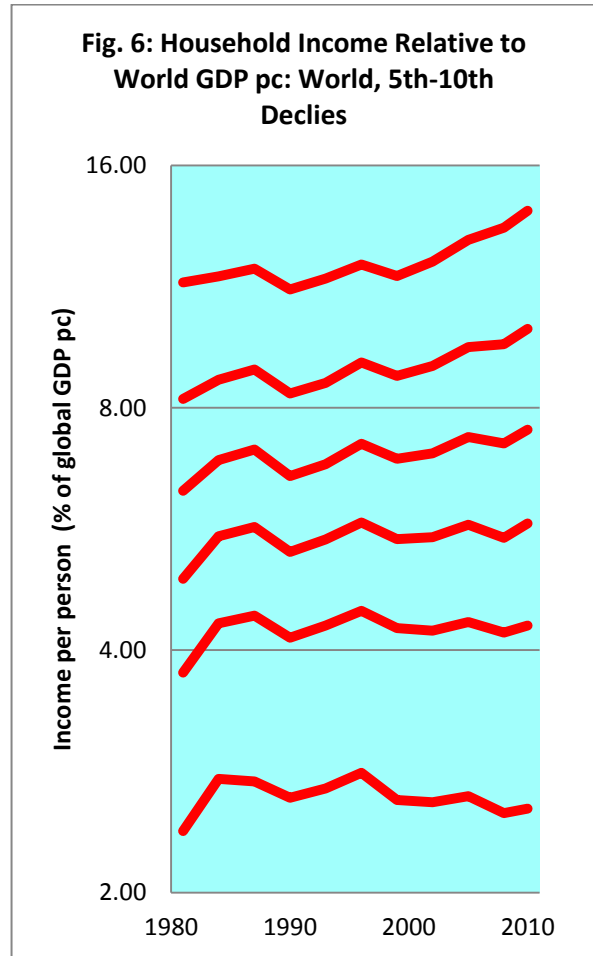
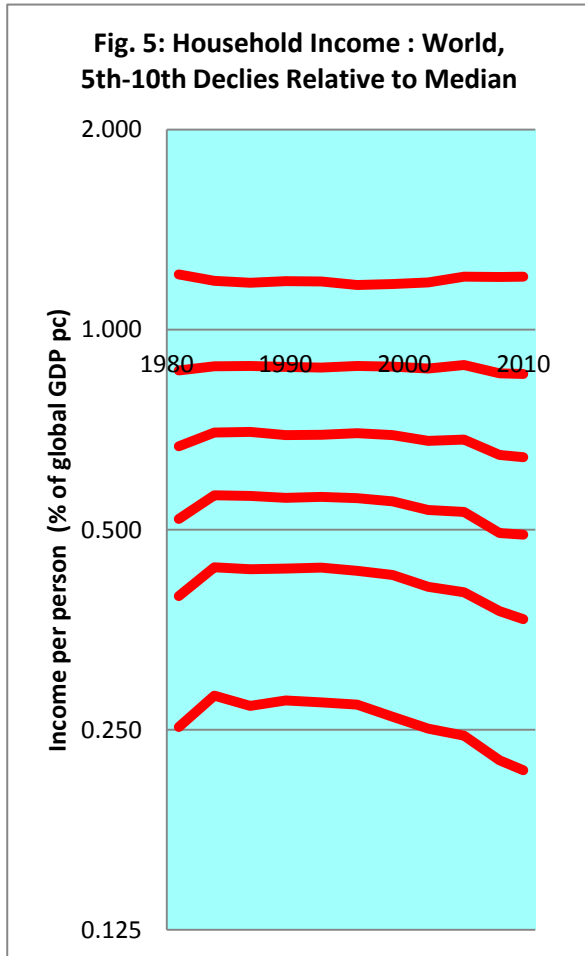


Moreover, this pattern of divergence is extremely consistent: the average income in every income band fell relative to every higher band in virtually every three-year period since 1996 (except for increases of 0.09% in the tenth decile relative to the ninth between 1999 and 2002, and of 0.04% in the seventh decile relative to the sixth between 2002 and 2005).

This gives rise to a marked divergence in the lower 60% of the world income distribution from 1996 onwards. The ratio of the average income in the lowest decile to the median rose from 0.252 in 1981 to a consistent 0.281 in 1984, declining slowly to 0.273 in 1996 (at 0.0007 pa), then much more quickly to 0.217 in 2010 (at 0.004 pa) in 2010. (See Figure 5.)

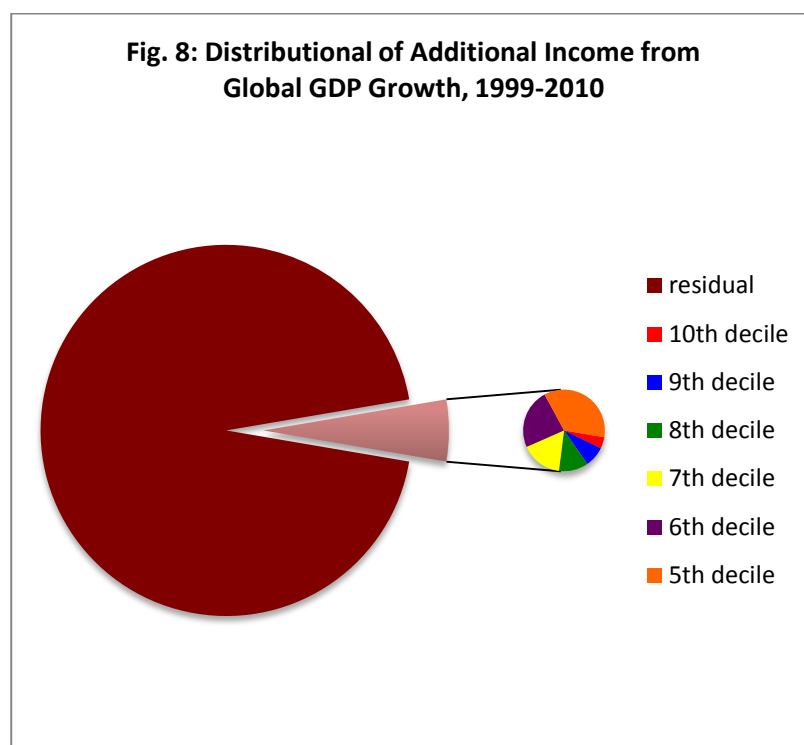
A third issue for concern is the relationship between global economic growth and the incomes of the poorer 60% of the world population. As discussed in *Growth Isn't Working* (Woodward and Simms, 2006), this is a critical issue in the context of potential carbon constraints to future global growth. While the picture presented by the estimates here is less pessimistic than in those presented in *Growth Isn't Working*, it is far

from positive, showing a significant reduction in per capita incomes in the bottom two income deciles relative to global GDP per capita since 1996. (See Figure 6.) The picture for the lowest decile is particularly bleak, with a cumulative reduction of 9.8%.



Unsurprisingly, the share of the proceeds of global growth attributable to the lower income deciles is very small. It also shows a significant regressive shift since 1981: the share of the bottom decile in the additional income generated by global growth fell by nearly a third, from 0.33% in 1981-90 to 0.24% in 1999-2010, with somewhat smaller falls (from 0.53% to 0.44% and from 0.65% to 0.63%) in the eighth and ninth deciles, while the shares of the fifth, and particularly the sixth and seventh deciles increased. (See Figure 7.)

To set this in context, the poorest 30% of the world population received just 1.2% of the additional income generated by global GDP growth between 1999 and 2008, the poorest 60% received 5.0%, while 95% accrued to the richest 40%. (See Figure 8.)



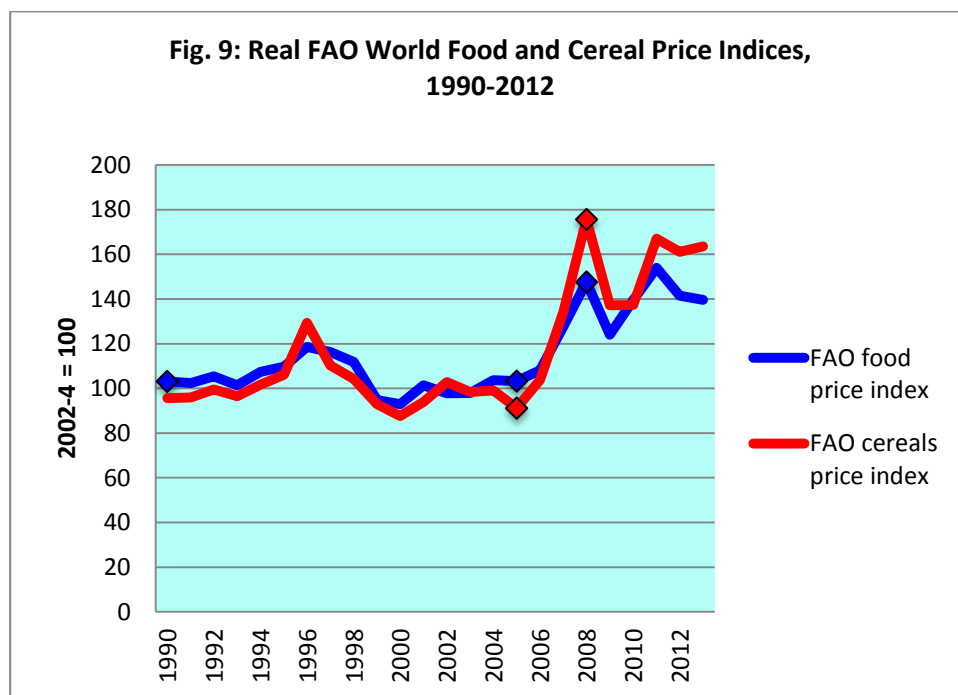
The fourth issue for concern is the effect of the major increases in food prices since 2005. Global cereal prices rose very considerably between 2005 and 2008 (see Figure 9); and this will inevitably have been reflected in the prices paid for basic foods by poor households. This renders the interpretation of poverty estimates based on PPP exchange rates extremely problematic, as these are based on GDP weightings (ie overall consumption) rather than on the consumption patterns of poor households themselves (Pogge and Reddy, 2006; Woodward and Abdallah, 2010).

PovcalNet income estimates attempt to adjust for this effect.

The steep rise in food prices in 2008 has been taken account by re-weighting the CPI whenever possible to accord with the food share in a neighborhood of the poverty line. We have done this for as many countries as these data are available, and where food price increases much faster than the national inflation rate.³

While helpful, however, this would appear inadequate because it does not differentiate between the *composition* of food expenditure at very low incomes and in overall consumption. The caveat “where possible” suggests that this adjustment is only partial; and, while this is not specified, it also seems likely that this adjustment is based on consumption at a single poverty line (presumably \$1.25 per day), which would make the adjustment still more inadequate at lower incomes.

³ <http://iresearch.worldbank.org/PovcalNet/index.htm?0,2>, accessed March 2013.



Source: FAO (2013).

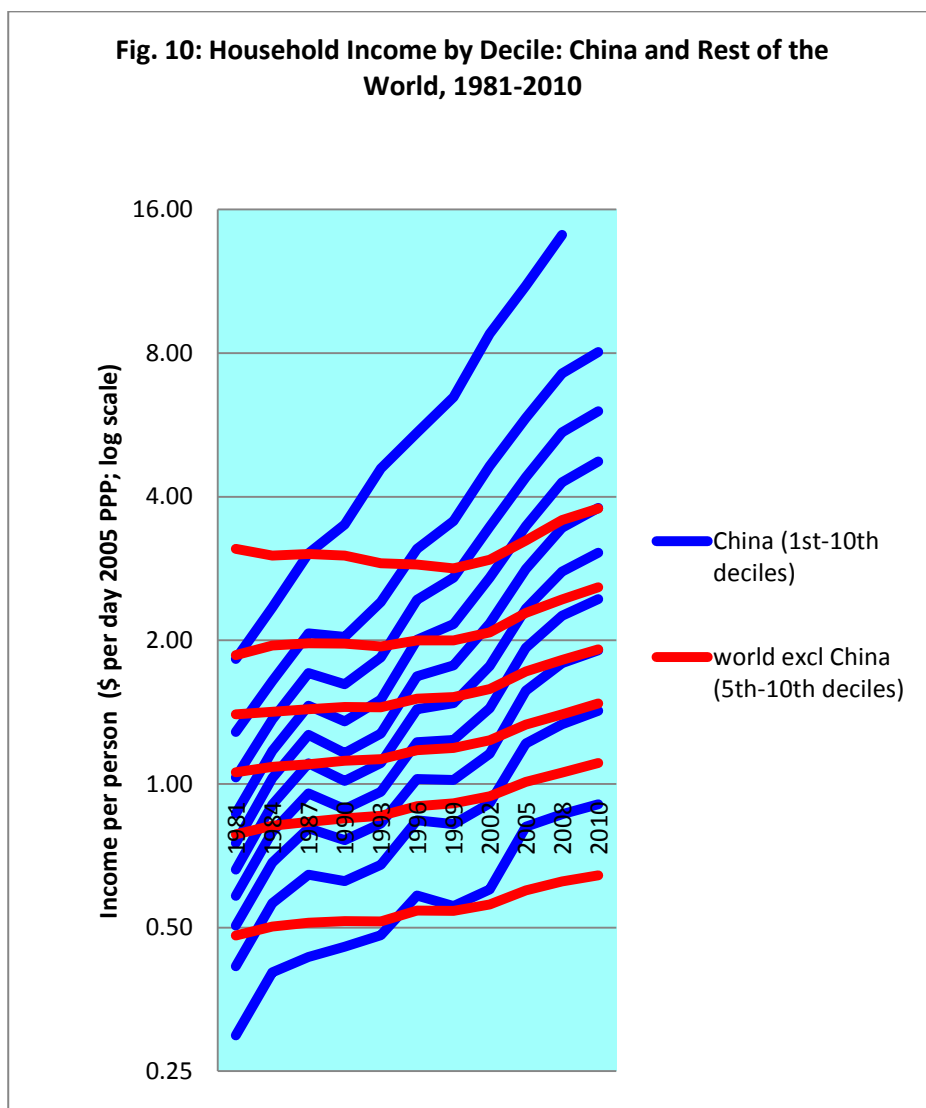
More fundamentally, the raw staple content of food expenditure (eg of maize or rice) at very low incomes is typically much greater than at higher incomes, where diets are more varied and various forms of value-added comprise a much greater proportion of food expenditure. Between 2005 and 2008 (the points highlighted in Figure 9), cereal prices rose by 92.6% in real terms, more than double the increase in overall food prices (42.9%). It also seems inevitable that non-commodity value-added costs (for processing, packaging, transportation, trading, etc), other than fuel costs, will have risen considerably more slowly than food commodity prices, and more particularly cereal prices, during this period.

The clear implication is that changes in overall national food price indices between 2005 and 2008 will considerably under-estimate the increase in food costs to the poorest households, rendering the adjustment of the PovcalNet poverty estimates inadequate.

The scale of cereal price changes, and of the difference between the increases in cereal and overall food prices, in this period suggest that this effect is likely to be very considerable. (See, for example, Ivanic and Marti, 2008; Ivanic *et al*, 2011.) While the scale of the discrepancy not readily quantifiable, the picture in terms of the actual living standards of those at the bottom of the global income distribution is thus substantially more negative in recent years even than the above estimates suggest. This should be borne in mind throughout the discussion which follows.

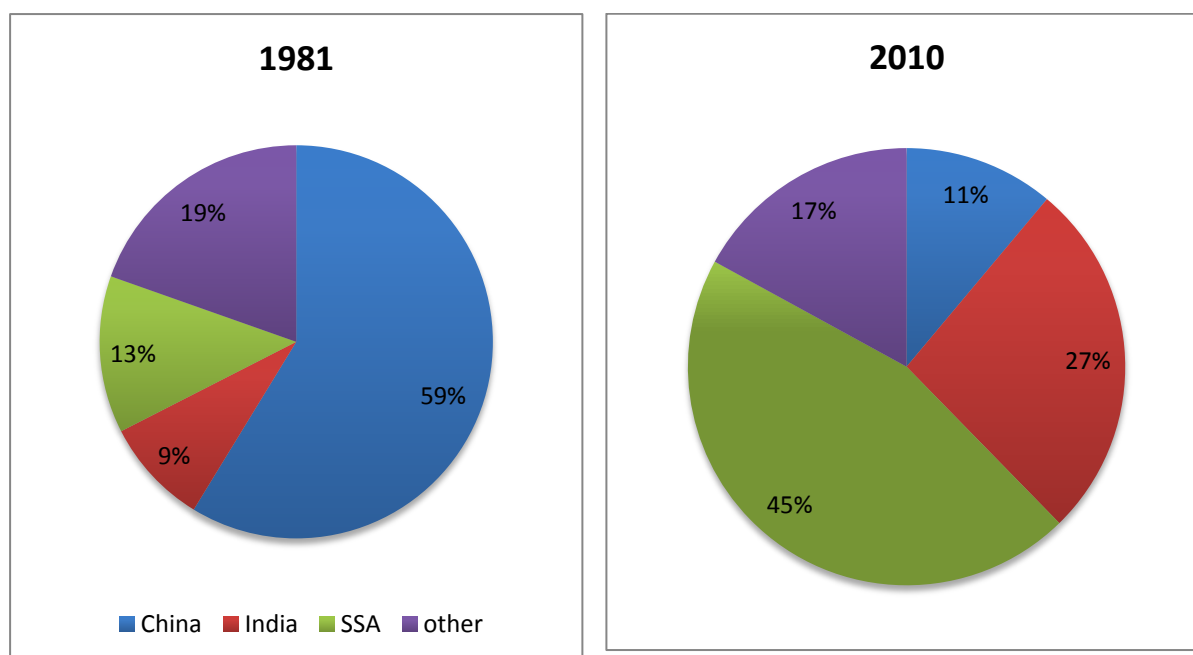
The final issue for concern is the geographical distribution of changes in income. It is generally recognised that the reduction in poverty in recent decades is disproportionately attributable to increasing incomes in China. Due to the combination of a very large population and very low estimated incomes, developments in China inevitably have a disproportionate impact on any global estimates of changes in poverty over the last three decades; and the markedly different pattern of income growth in China as compared with the rest of the world during this period means that assessing the evolution of decile income averages for the world as a whole may give a misleading (and, overall, artificially optimistic) impression of developments in poverty across the rest of the developing world.

The scale of the difference in trends between China and the rest of the world – and its potential implications for the above analysis – can be gauged from Figure 10. While incomes in the second to tenth deciles of the Chinese population has been much faster than the growth rate of global GDP per capita since 1981, that of the 6th-10th income deciles in the remainder of the world has been much slower.



This has two implications. The first is that the above estimates of incomes for world income deciles are likely to over-state rates of increase for the world excluding China by a substantial margin, and thus to present a much more optimistic (or less pessimistic) picture than is representative of the developing world outside China.

The second, however, with regard to the finding of an increasingly regressive trend in the distribution of income among the bottom six deciles of the world population, is a more nuanced one. As incomes in China have grown rapidly relative to incomes in the rest of the world, so the proportion of the lowest income bands of the world population represented by China has fallen markedly. (See Figure 11.) By 2008, China accounted for only 11.5% of the bottom world income decile, compared with 58.7% in 1981. By contrast, the combined share of Sub-Saharan Africa and India increased from 25.0% to 73.1%.

Figure 11: Geographical Composition of World Lowest Income Decile, 1981 and 2008

Given the much faster increase in incomes in China than in the remainder of the developing world (taken as a whole) during the period under consideration, it thus seems likely that the increasingly regressive distributional shift observed above may be attributable, partly or wholly, to a shift in the composition of lower income bands from Chinese households with rapidly rising incomes to non-Chinese households with more slowly increasing incomes.

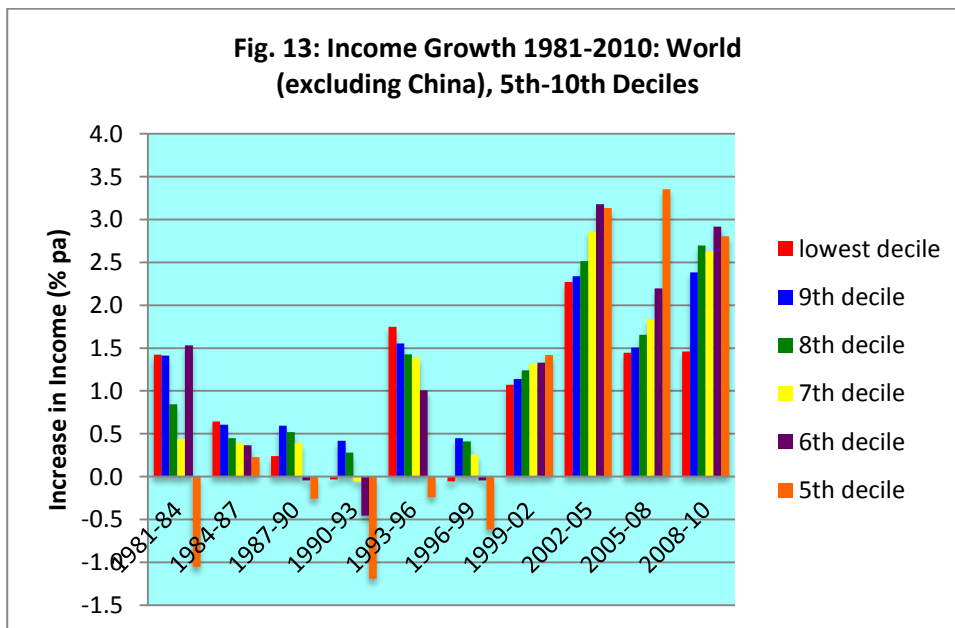
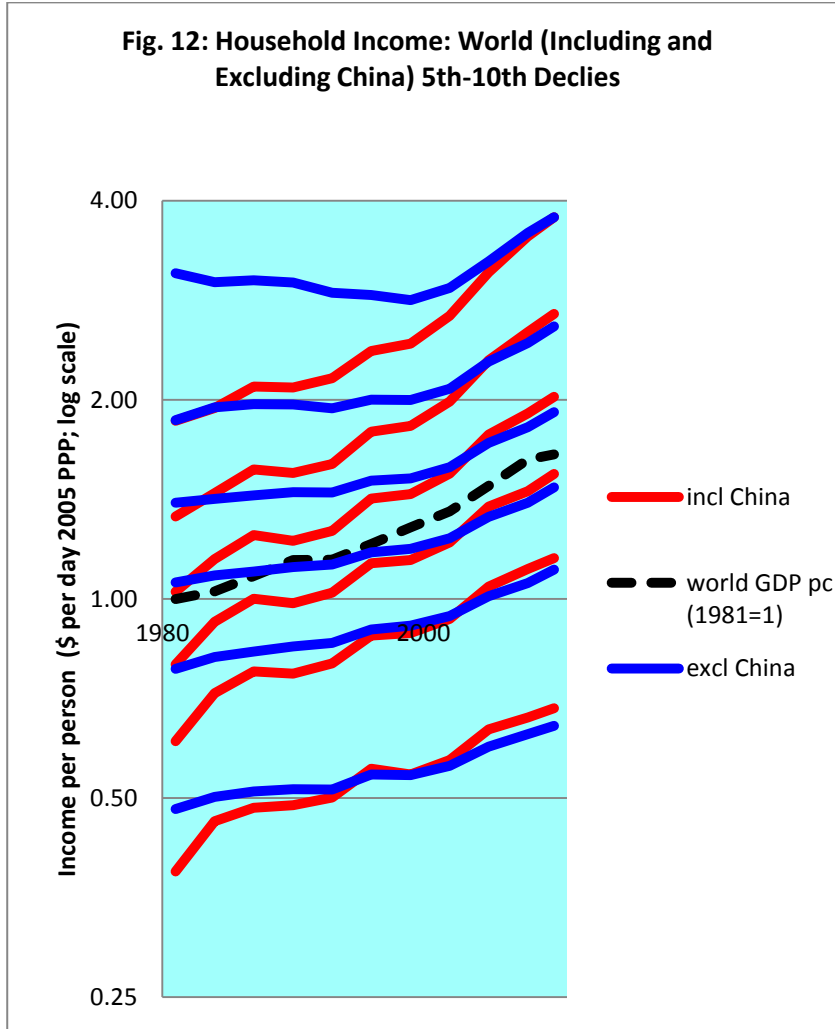
In any event, it seems clear that we cannot adequately understand the evolution of the incomes of poor households without separate consideration of developments in China and in the remainder of the developing world.

4. Evolution of incomes by decile: world excluding China

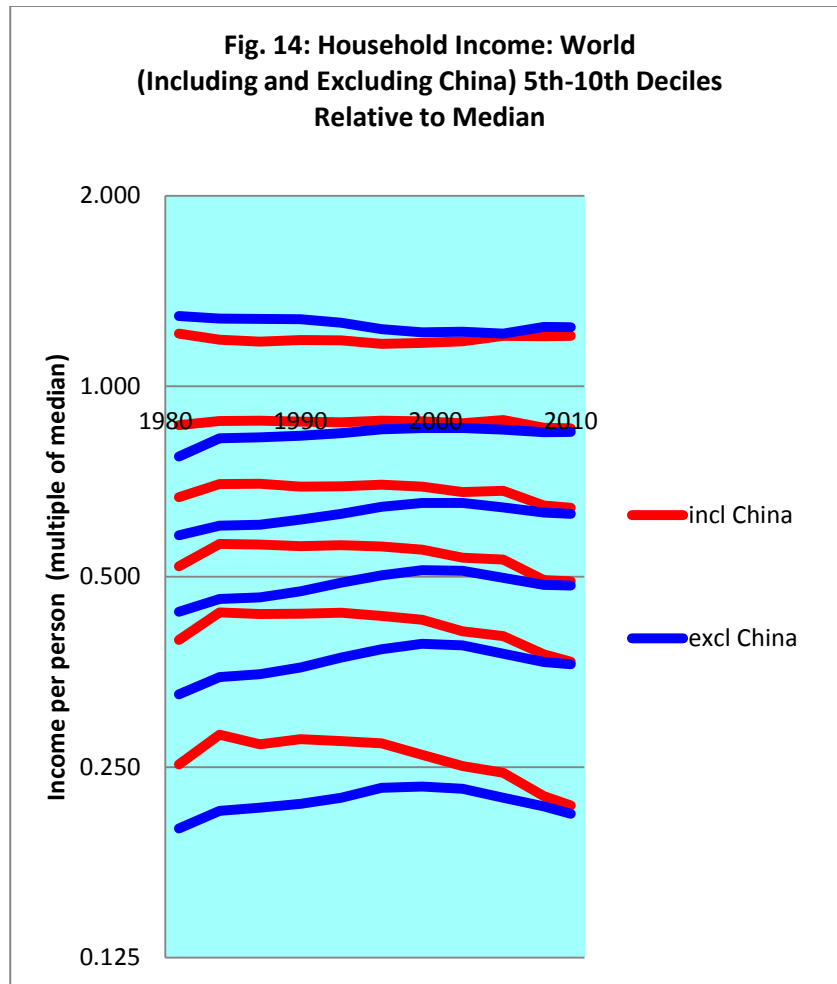
The evolution of average incomes for the fourth to tenth income deciles of the population of the world excluding China are shown in Figure 12. The most striking feature is the much slower income growth across all income bands when China is removed from the analysis. While this shift appears relatively limited in the lowest band (apart from the much more limited increase in 1981-4), it is nonetheless substantial: between 1984 and 2008, the average income rose by an average of 0.9% pa in the lowest decile for the world excluding China, compared with 1.5% pa for the world as a whole.

The difference is still more marked in the higher income bands, particularly in the first half of the period. For the fifth decile of the world population as a whole (the highest considered here), average income actually fell between 1981 and 1999, although it grew relatively strongly in 2002-10, giving rise to an average rate of increase for the period as a whole of 0.7% pa. This compares with an average increase for the corresponding (ie fifth) decile of the world as a whole of 2.5% pa.

Comparing deciles with similar incomes in 1981 gives rise to the same pattern. The sixth, seventh, eighth and ninth deciles of the world excluding China have approximately the same initial incomes respectively as the fifth, sixth, seventh and eighth deciles of the world as a whole. Comparing income growth in 1981-2010 for the corresponding deciles demonstrates the dramatic effect of removing China from the analysis. The annual income growth rates for the world excluding China bands are respectively, from the highest (with those for the corresponding bands in terms of initial income for the world as a whole in brackets) 1.2% (2.3%), 1.2% (2.4%), 1.1% (2.5%) and 1.1% (2.5%).



Considering income growth rates by decile over the course of the period to 2010 also suggests two more positive conclusions. First, there has been a significant acceleration in income increases since 1993: between 1981 and 1993, average growth rates ranged from -0.6% to +0.8%; between 1993 and 2008, they were in a much narrower range, from +1.0% to +1.1%. (See Figure 13.) Second, the initial convergence in incomes persists much longer before giving way to divergence, continuing until 1999 rather than 1984 (Figure 14). The rate of divergence is also slower, even after 1999.



However, the much slower income growth rates than for the world as a whole also signify a much more consistently negative pattern relative to global GDP per capita. (See Figure 15.) In contrast with the results for the world as a whole, the average incomes of all deciles decline continuously as a percentage of World GDP per capita, with a marked downward convergence until 1999, after which there is a partial levelling-off in the upper deciles (and a more general upward tick in 2008-10, as the marked slowdown in global GDP growth was not reflected in incomes in the 5th-10th deciles). The average income in the tenth decile declined from 3.0% to 2.4% of world GDP per capita between 1981 and 2008, and that of the fifth decile from 19.1% to 13.6%.

If we compare instead with per capita GDP for the world excluding China, a broadly similar pattern emerges. (See Figure 16.)

Fig. 15: Household Income Relative to World GDP pc: World (Including and Excluding China), 5th-10th Deciles

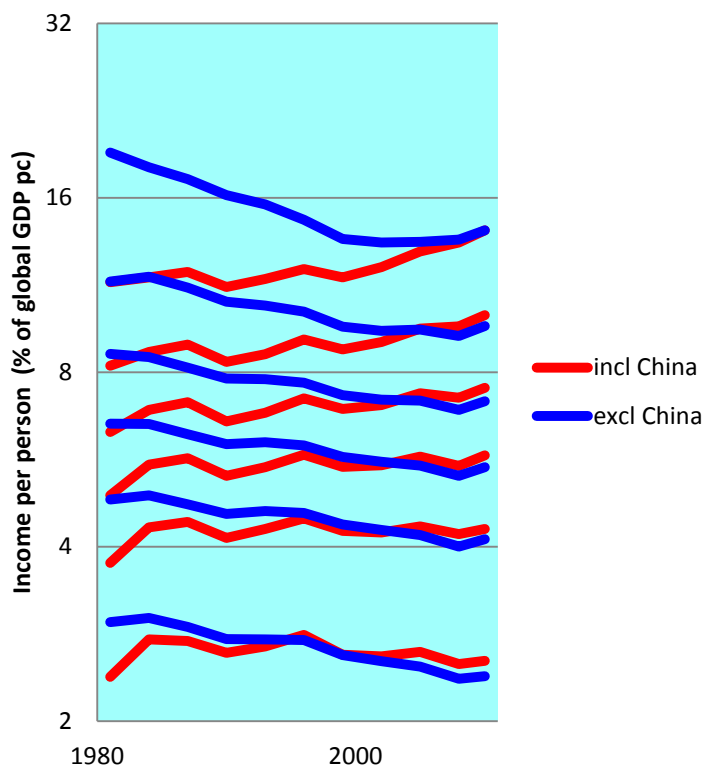
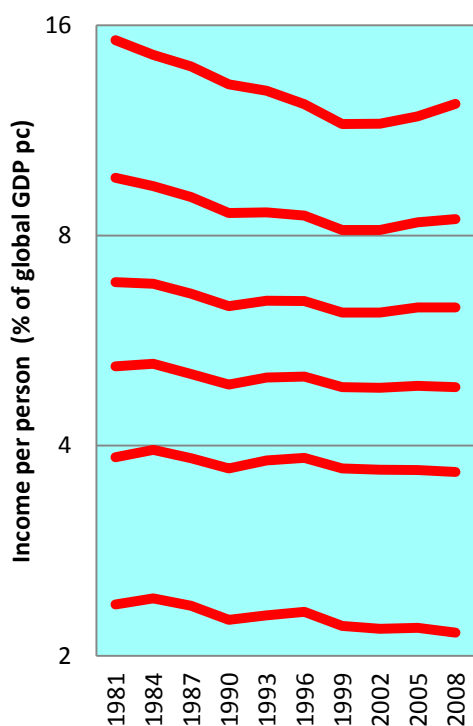
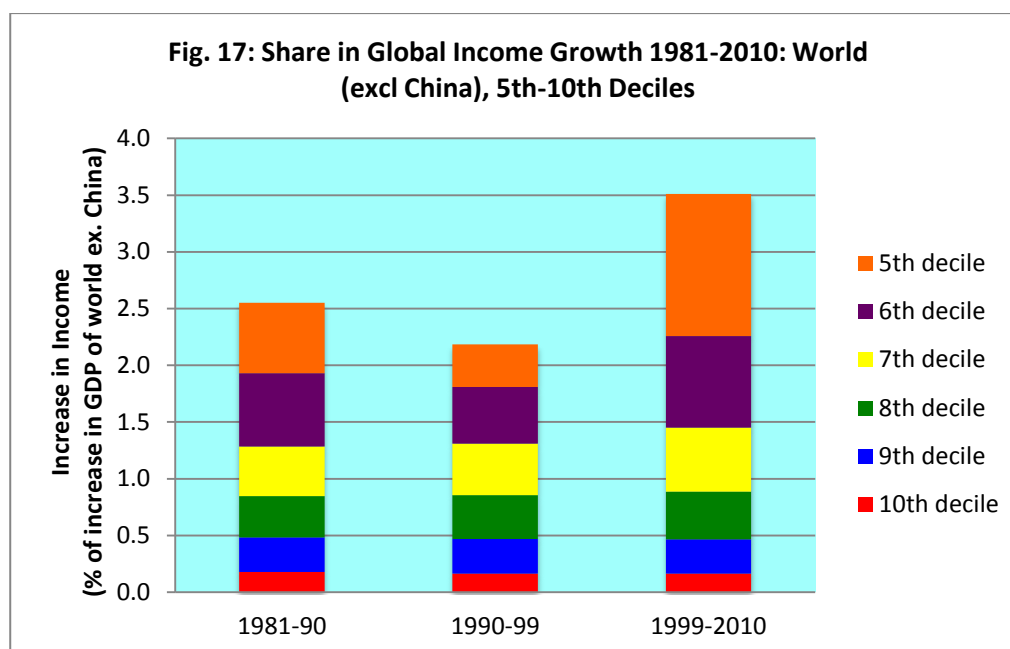


Fig. 16: Household Income Relative to World (excl China) GDP pc: World excluding China, 5th-10th Deciles





The decline in incomes relative to global GDP per capita is also reflected in still smaller shares for the lower income deciles in the additional income generated by global growth. (See Figure 17.) Even in the period from 1999, the poorest 60% of the population of the world excluding China (equivalent to 48.0% of the world population at the end of the period) accounted for only 3.5% of the proceeds of global growth. The shares of the fifth and sixth deciles declined sharply in the 1990s, but recovered strongly after 1999, while that of the seventh decile increased slightly throughout the period. However, the shares of the lowest three deciles remained virtually unchanged overall, at just under 0.5%, with a degree of divergence: while the share of the eighth decile increased from 0.36% to 0.42%, that of the poorest decile fell from 0.18% to 0.16%.

5. “Always with us”? Implications for poverty eradication

The following discussion considers the implications of the above analysis, and specifically how long it would take to reduce poverty to zero (or near zero) if recent trends in income growth were sustained indefinitely. Two poverty lines are considered: the \$1.25-a-day poverty line, as that currently most widely used; and a \$5-a-day line, which might be considered a more realistic reflection of the income at which basic needs may be met, and social and economic rights minimally fulfilled.

At the simplest level, the growth rate of per capita incomes in the lowest world income decile from 1981 to 2010 (2.0% pa), if sustained indefinitely, would raise the average income for the band from its 2008 level (\$0.68) to the \$1.25 per day poverty line in 2041; but it would reach \$5 per day only around 2115. However, this represents only the *average* income for the lowest decile. To raise the *lowest* incomes to this level – that is, to eradicate poverty by this criterion – would take considerably longer.

To assess this, we assume, *ex hypothesi*, (a) that the poorest households have incomes of half the average for the lowest decile, and (b) that their incomes increase at the same rate as the decile average. It should be emphasised that both of these assumptions err on the side of optimism. In 2008, 66m people (1.0% of the world population) had incomes below this level, and 16.7m below half of this level (although it seems likely that the PovCalNet estimates become unreliable at such low incomes). Equally, if the divergence between the income bands noted below were replicated within bands, the incomes of those at the bottom of the tenth decile might be expected to grow more slowly than the average for the band.

Nonetheless, even on the basis of such optimistic assumptions, extrapolating the rate of income growth for the tenth decile would imply as a best-case scenario that poverty would not be eradicated until 2077 – well beyond the life expectancy of those born today in the poorest countries – based on the \$1.25 a day line, and 2148 based on the \$5-a-day line.

As discussed above, however, the global figures are potentially misleading because of the exceptional performance of China. Clearly, the much slower income growth rates for the world excluding China than for the world as a whole imply a much longer period for the eradication of poverty. To maintain the optimistic bias, we consider the period of most rapid growth in the incomes of the poorest decile, from 1993 to 2008, excluding the slower growth of 1981-93 and the crisis (2008-10) period. It should also be noted that no adjustment is made for the potential under-estimation of food price effects in 2005-8, as discussed above, or for any slowdown in income growth after 2010 as a result of the financial crisis.

Again taking half of the mean income of the lowest decile as the minimum income, extrapolating the 1993-2008 income growth rate from 2010 would result in poverty being eradicated only in 2116 (according to the \$1.25-a-day poverty line) or 2224 (using a \$5-a-day line). In other words, ***even if we were to resume the pre-crisis pattern of income growth immediately and sustain it indefinitely, extreme poverty would persist for more than a century, and absolute income poverty by a broader definition for more than two centuries.*** It should also be noted that the use of half the mean income in the lowest decile as a proxy for minimum incomes means that around 1% of the world population would remain in poverty by the respective definition. This represents some 85-90 million people, more than the current population of Germany or the Eastern Seaboard of the US from Maine to South Carolina.

This impasse arises fundamentally because the incomes of the poorest are growing much more slowly than global GDP: between 1993 and 2008, the average per capita income of the poorest decile of the world population excluding China increased only half as much as world GDP per capita, by 21.3% compared with 41.7%.

As noted above, 1993-2008 is the period of maximum growth in the incomes of the poorest decile. This undoubtedly reflects a number of favourable shifts in development policy during this period, as piecemeal debt cancellation limited to commercial and bilateral debts gave way to comprehensive debt reduction under the Enhanced HIPC Initiative; structural adjustment programmes gave way to poverty reduction strategy papers; the Millennium Development Goals were adopted in 2000; per capita aid receipts more than doubled between 2001 and 2008 (DAC, 2012); and increasing attention was devoted to aid effectiveness following the Paris Declaration after 2005.

By extrapolating income growth rates from the 1993-2008 period, we are thus implicitly assuming a continuation of this pro-poor shift at a similar rate into the indefinite future. This, again, is a very optimistic assumption.

Thus, even if we were to succeed in returning to the pre-crisis trajectory of the global economy, continuing the pro-poor shift in development policies and assuming no adverse effects from climate change, and on the most optimistic assumptions, poverty eradication in any meaningful sense is not a matter of decades or even generations, but of lifetimes or centuries. The prospect of poverty eradication based on a \$5-a-day poverty line is nearly as far off in the future as the French Revolution and American Independence are in the past.

6. Alternative scenarios: growth, distribution and global carbon constraints

In principle, there are two ways in which the process could of poverty eradication be accelerated: by increasing the growth rate of the global economy as a whole; or by increasing the share of global growth which goes to the poorest households (that is, by changing the global income distribution to the benefit of the poorest).

However, global carbon constraints raise serious questions about the former option. The baseline scenario outlined above entails an increase in global GDP (in 2005 PPP terms) to nearly 15 times its 2010 level by the time \$1.25-a-day poverty is eradicated in 2115, and 173 times its 2010 level by the time of \$5-a-day poverty eradication in 2222. The contribution of population growth to this figure (based on current UN projections) would be limited in the former case, and minimal in the latter – a factor of 1.29 and 1.25 respectively. Rather, the increase is almost entirely due to growth in world GDP per capita, which would reach around \$112,800 in 2115 and \$1,358,000 in 2220, respectively 3.3 and 40.2 times the current figure for high-income OECD countries.

Table 2: Poverty Eradication Scenarios: Summary of Results

		Growth assumptions (% pa)		“poverty eradication”		
		poorest	GDP pc	year	GDP pc (\$)	GDP (2010=1)
\$1.25-a-day	Baseline	1.29	2.35	2115	112,800	14.9
	High-growth	2.20	4.00	2072	111,600	14.8
	Proportional	2.35	2.35	2068	37,800	5.0
	Pro-poor	4.20	2.35	2042	20,600	2.6
\$5-a-day	Baseline	1.29	2.35	2222	1,358,000	173.3
	High-growth	2.20	4.00	2136	1,374,000	176.0
	Proportional	2.35	2.35	2128	152,580	19.8
	Pro-poor	4.20	2.35	2076	45,500	6.1

If global GDP per capita were to increase at 4% pa, keeping other assumptions as in the baseline scenario (and maintaining the ratio between GDP growth and the growth rate of incomes in the poorest decile as in the baseline scenario), the time required to eradicate poverty would be reduced by 43 years at \$1.25-a-day and by 64 years at \$5-a-day (although eradication would still occur only in 2072 and 2136 respectively).

However, since the ratio between the income growth rate for the poorest decile and global GDP growth would (*ex hypothesi*) remain unchanged, and world population is projected to be relatively constant between 2072 and 2222, the level of both world GDP and GDP per capita at the point of poverty eradication would remain virtually unchanged from the baseline scenario. Thus the time available for technological adaptation to neutralise the environmental impact of such high levels of consumption and production would be greatly reduced, raising serious questions about the viability of this scenario, particularly in a context of increasingly binding global carbon constraints.

In this context, unless we simply dismiss the problem by assuming unlimited potential to reduce the carbon intensity of global GDP through technological changes, the relationship between poverty reduction and global production and consumption is critical. From this perspective, any scenario which fails to increase the growth rate of the income of the poorest decile relative to that of global GDP appears, quite simply, untenable from the perspective of sustainable poverty eradication.

Poverty eradication based on a \$5-a-day poverty line requires an increase in the incomes of the 62.3% of the world population below this income level in 2010 by a total amount equivalent to around \$4.57 trillion, or 6.8% of global GDP (at 2005 PPP). In the baseline and high-growth scenarios – which, as noted above, implicitly assume an indefinite continuation of the pro-poor shift in development policy at the 1993-2005 rate – this not only takes between 123 and 209 years, but also requires an increase in global production and consumption by a factor of around 175 from the 2010 level, raising global GDP per capita above \$1.3m. Thus closing a poverty gap of \$4.5 trillion requires an increase in global GDP in excess of \$11,500 trillion.

In a global economy faced by increasingly binding carbon and other environmental constraints, an approach which entails increasing production and consumption by more than 2,000 times the additional income we are seeking to generate, in order to achieve our objective at a glacial pace, can at best be described as grotesquely inefficient.

It also seems highly likely to be unviable. Even allowing for two centuries of technological change (and improvement in global economic and environmental governance), it would seem extremely optimistic to assume that that an increase in global production and consumption on this scale could be achieved within global carbon constraints and without irreparable damage to global ecosystems which are already under

considerable strain even at current levels of economic activity (Millennium Ecosystem Assessment, 2003). Moreover, it is precisely the poorest who stand to suffer first and worst from the consequences of ecosystem failure.

Unless we assume that global economic growth has no adverse environmental effects, or that these do not affect the poorest, such consequences must be off-set against the projected increase in their incomes. For a given trajectory of the carbon intensity of global GDP, faster economic growth will generate additional carbon emissions, accelerating the increase in atmospheric carbon concentrations, and thus the process of climate change. This effect can only be neutralised if a given percentage increase in GDP in itself *induces* an equivalent proportional reduction in carbon intensity – that is, that a 1% acceleration in global growth necessarily brings about a 1% faster reduction in carbon intensity than could have been achieved at the slower growth rate. There is no obvious reason to believe that this is the case, and it would seem difficult to construct a rationale for making an assumption to this effect. Essentially the same argument applies to other ecosystem services.

At best, this means that the acceleration in poverty eradication as a result of faster global growth will be significantly less than indicated above. It also raises a real possibility that faster growth could be counter-productive. Even if we assume (contrary to the general view) that the poorest suffer no more than the average in terms of the impacts of climate change, a positive net effect of faster global growth on the bottom decile requires that the impact of an additional \$100 of global production, through its effect on carbon emissions, is less than about \$2 (equivalent to the share of the poorest decile in global growth between 1993 and 2008 relative to their *pro rata* share of 10%). This would again seem an extraordinarily optimistic assumption – but without it, we are forced to the conclusion that, from a poverty perspective, it is only such increases in GDP as contribute directly either to poverty reduction or to reducing the carbon intensity of global production and consumption that are justified.

The key issue is thus, not the growth rate of the global economy, but rather the relationship between global GDP and the incomes of poor households, and that between global GDP and global carbon emissions. In effect, this amounts to shifting away from global growth as an objective in itself.

The implications of such a shift can be demonstrated by comparing the high-growth scenario outlined above with scenarios which vary the relationship between global GDP growth and the growth rate of incomes in the poorest decile at the baseline rate of global growth.

If we consider a “proportional” scenario, in which the incomes of the poorest decile rise at the same rate as global GDP per capita, while maintaining global growth at the 1993-2008 rate, the effect on poverty eradication is marginally better than that of “high-growth” scenario: poverty is eradicated in 2068 at \$1.25-a-day and 2128 at \$5-a-day (respectively four years and eight years earlier). The key difference, however, is the increase in global GDP which is required, which is reduced by a factor of around three in the former case and nine in the latter. This clearly increases the possibility of environmental sustainability considerably.

In the final scenario, we take a step further in this direction, and assume a pro-poor bias in global growth equivalent to the anti-poor bias in 1993-2008, changing the ratio of income growth for the poorest decile to that of global GDP per capita from 0.55 to 1.82. This results in poverty eradication based on the \$1.25-a-day poverty line by 2042 (global GDP increasing by a factor of 2.6), and \$5-a-day by 2076 (global GDP increasing by a factor of 6.1), respectively 30 and 60 years sooner than in the “high growth” scenario, and 73 and 146 years sooner than in the baseline scenario. The scale of the increase in global GDP required is reduced by a factor of more than 28.

This raises the question of how such a shift could be achieved. As noted above, the relationship between the incomes of the poorest decile and global GDP between 1993 and 2005, unfavourable as it was, itself reflected a marked improvement in the primary instruments for poverty reduction within the current model of development – aid, debt cancellation and the economic policies promoted by the IMF and World Bank in low-income countries. If we are to go substantially further than was achieved by these changes, this implies a much more fundamental shift: a reassessment of the current models of the global economy and of development in terms of their impacts on the poorest, and of their long-term viability and sustainability in a carbon-constrained world, and a real willingness to make fundamental changes in both to maximise their poverty impact and sustainability.

This challenge extends far beyond the scope of the present paper; but, if we genuinely want to eradicate poverty in a meaningful sense within a reasonable timeframe – decades rather than centuries – then it is a challenge we must address as a matter of urgency.

7. Conclusions

Even on the most optimistic assumptions, and even if we sustain the rate of increase in attention to poverty seen since the early 1990s, relying on global economic growth seems an almost certain route to ensuring that the poor are, indeed, “always with us”: such benefits as may trickle down from global growth to the poorest will almost inevitably be countered by the adverse effects of climate change and the costs of adaptation. The only viable route towards eradication of poverty, by a meaningful definition and within a remotely reasonable timeframe, is to improve the relationship between global economic growth and poverty – and to do so much faster and more effectively than has been achieved over the last 20 years.

This means shifting our attention from global economic growth itself, and towards improving the distribution of the benefits of global production and consumption. The instruments available within the current global economic model achieved a marked improvement between 1981-93 and 1993-2008; but even this has proved inadequate to make the prospect of poverty eradication a realistic one, at least before the 23rd century, and, in all probability, ever.

If we are to make poverty eradication a real possibility, if not within our own lifetimes, at least within those of our children or our grandchildren, there seems little choice but to move beyond limited “add-on” solutions such as aid and debt relief to reassess fundamentally our whole approach to development and to the global economy, and to make such changes as may be required to make it fit for purpose.

Annex: Data Sources and Methodology

All estimates relating to income bands are the author’s estimates based on data from PovcalNet: the on-line tool for poverty measurement developed by the Development Research Group of the World Bank (<http://iresearch.worldbank.org/PovcalNet/index.htm?1>). Data for GDP and population are from the World Bank’s World Databank, Global Development Indicators and Global Development Finance (<http://databank.worldbank.org/ddp/home.do>). The methodology used to arrive at the estimates in this paper is outlined in Annex I, and detailed results in Annex II.

The following methodology was used for the estimation of decile average incomes.

1. Population data from the World Bank’s Databank database (<http://databank.worldbank.org/data/home.aspx>) were used to estimate the number of people constituting 10% of the world population.
2. Using the World Bank’s PovcalNet database (<http://iresearch.worldbank.org/PovcalNet/index.htm>), an iterative process was used to identify the poverty line (in international dollars per person per month at 2005 purchasing power parity) generating the closest number of people in poverty to 10%, 20%, 30%, 40%, 50% and 60% of the population in the geographical area under consideration. (Note: in the case of the world as a whole and the world excluding China, this is based on an assumption that the number of people in the developed world with incomes below each poverty line is negligible.)
3. Based on world population, the poverty lines thus identified (L) and the corresponding poverty headcount ratio (R) and poverty gap (G), the cumulative income up to each of these poverty lines (Y_{CL}) was estimated as: $Y_{CL} = N * L * (R - G) / 100$
4. The average income within each income band (in international dollars per person *per day* at 2005 purchasing power parity) was estimated as the difference between the cumulative income below each band and that below the previous band, divided by the difference between the total population below each band, multiplied by 12/365.

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